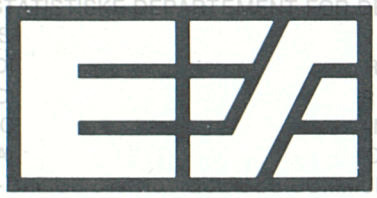

COMMUNITY INPUT-OUTPUT TABLES 1970-1975 METHODOLOGY

SPECIAL SERIES

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COMMUNITY
INPUT-OUTPUT TABLES
1970-1975 — METHODOLOGY

This publication was prepared
by M.J. Green and P. Le Grontec

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CONTENTS

Introduction

The increasing variety and complexity of economic activity require the constant development of both economic theory and economic statistics, particularly when it is necessary to demonstrate the interdependence within an economy or between economic systems. It is impossible to obtain a clear picture of this interdependence without as exact a knowledge as possible of how important economic variables behave and what the relationships between them are.

A detailed and systematic presentation of the significant economic variables is the key to obtaining a clear picture of economic interdependence. This can be done by gathering together statistical information on production, consumption, investment, imports and exports for enterprises, households and government bodies referring to a certain period, such as a year. Input-output tables then provide a framework for assembling this detailed information in a systematic way. They also make it possible to introduce the data into the national accounts.

The first attempts to provide numerical estimates of economic interdependence were made long ago, the best known being François Quesnay's Tableau économique. However the more recent importance assumed by input-output tables is due to the work of Wassily Leontief who, some 40 years ago, established them as a normal tool for economic analysis.

The data which make up an input-output table represent flows, that is to say purchases and sales between economic agents and cover the economic activities of one year. As a large number of statistical sources are used, and as a certain amount of time is required to collect and process the data, the final tables are often not ready until four or five years after the year to which they refer and this may make them appear to be no longer of interest.

The input-output tables do, however, reveal a large number of basic economic relationships—such as the structure of production and demand—which develop gradually and more or less continuously through time. A table referring to a period four or five years before the date of completion can therefore still be extremely useful.

Because input-output tables are so widely used, the Statistical Office of the European Communities (EUROSTAT) has published comparative tables for the original six Community countries for the years 1959 and 1965. The definitions used in the tables and the classifications employed are taken directly from the European System of Integrated Economic Accounts (ESA). The Statistical Office is now working on three series of tables for the nine Community countries using a common system of classification and common definitions.

The first is a series of annual tables starting with the year 1970. They will be available usually three to four years after the year to which they refer; the second series will be prepared every five years, that is for 1970, 1975 and so on. They will take the same general form as the annual tables but will be more detailed and will therefore take longer to produce. They will also be used in the preparation of statistical series at constant prices provided by the Statistical Office of the European Communities. Thirdly, there will be a series of constant price annual tables.

This methodology describes firstly the simplified annual tables, including those drawn up at constant prices, and secondly the more detailed five-yearly tables.[1] It is divided into three sections.

The first section deals with the basic principles involved in using input-output tables to present economic interdependence systematically (Chapter 1).

After this general outline, the second section (Chapters 2 and 3) gives the exact definitions and rules to be followed in the tables to ensure consistency in time and comparability between countries. The third section gives details of some analyses for which the tables can be used (Chapter 4). There are many such analyses and they form an integral part of this methodology because they embody the principle of interdependence on which the tables are based.

[1] It follows on from the Methodology for the Community input-output tables for 1965, Statistical Office of the European Communities, Special series 1-1970 (and updates it without repeating all the details).

CHAPTER 1

Description of an elementary input-output table

(a) General principles

An input-output table provides a clear picture of the relationships between a large range of economic variables that refer to a given year and a given economic system. In order to understand how such a table can be constructed, it is necessary to consider all the goods and services produced in, or imported into, an economic system and the use to which they are put. These goods include agricultural products, manufactured goods of all types, as well as the output from building or civil engineering activities. The services include those provided by transport, wholesale and retail trade, and the services of financial institutions. These goods and services are produced by a considerable variety of producer units, farms, factories, airports, banks and administrative bodies.

As the range of goods and services produced, imported and used in any economy is so wide, they must be classified according to their usage or technical specifications into sufficiently large homogeneous groups if numerical estimation of the transactions involved is to be practical. For the sake of simplicity, these groups are called groups of products.

In the same way producer units can be grouped into branches of production. If this grouping is organized in such a way that the main products of these producer units correspond to the goods or services in one of the groups of products, then the classification of branches will be coherent with the classification of products.

Consequently, all the producer units in the economic system belong to a particular branch of production, each of which produces a group of related goods or services that belongs to a particular group of products.

Products produced by the branches of production and imported products are intended for two distinct types of buyer. Firstly, many products are used by the branches as intermediate products or 'intermediate consumption inputs'. These goods and services are used to make other goods and services and are thus incorporated into other products.

Secondly, some goods and services are required to meet the needs of the consumption of households or of public bodies, for investment in fixed capital goods and stocks, and the needs of non-resident agents. In all these cases, once they have been purchased, the goods and services are not subject to further processing and are not incorporated into other products during the reference period or within the economic system under consideration. These products are therefore destined for 'final uses'.

Products consumed by households represent 'consumer demand' and include for example food, clothing, durable goods, transport, insurance etc. Collective consumption covers services provided by the state, such as education and defence. Fixed capital formation and investment in stocks include the purchase of plant and machinery, vehicles, building and civil engineering work.

The purchases of an individual product that has been made or imported into the country in question can be set down without difficulty as a row of transactions. The first part of the row records the intermediate consumption of the various branches. The other entries in the row cover the purchases intended for final use.

If there are m branches of production

and if

$X_1, \ldots, X_m$ represents the amounts purchased by the production branches, and

$X_{m+1}, \ldots, X_{m+5}$ the purchases for final uses,

and X the total of all these transactions, then they can be arranged as follows:

Intermediate consumption / Branches	Final consumption of households	Collective consumption	Gross fixed capital formation	Change in stocks	Exports	Totals
$X_1 \ldots X_m$	X_{m+1}	X_{m+2}	X_{m+3}	X_{m+4}	X_{m+5}	X

The flows or transactions for each individual product can be readily set out in a row in this way. If the classification selected covers n products, the result will be a table consisting of n rows where n is greater than or equal to m. However, given the definition of the branches and products set out above, n is equal to m in the following table.

	m branches	Five categories of final uses	Totals
m branches	intermediate consumption = products supplied to the branches	products for final use	

Each column in the first part of the table shows the range of products used by each branch. The sum of the entries in any one column gives the total value of raw materials, fuels, transformed goods and services required to maintain production in that branch.
Further costs incurred in the course of production are wages, the amount set aside to replace assets (fixed capital consumption), and taxes linked to production. The value obtained from the difference between the total costs and the price of the product on the market is the net operating surplus. These items, know as 'primary inputs' can thus be added to the preceding table.

Intermediate consumption	Sub-totals	Final use	Totals
Sub-totals	IC	Sub-totals	G_2
Primary inputs			
Totals	G_1		

The total of the entries in any one column shows how the value of the product of each branch is made up of raw materials, fuels, finished goods and services, salaries and wages, capital consumption and the net operating surplus. The row 'totals' gives the total inputs which equal the total value of the products because the net operating surplus forms the balance. The table also shows how the product is distributed according to category of use.
This flow table is an input-output table and is divided into three distinct sections:
1 — a table of intermediate consumption — products supplied by one branch and intended for the same or another branch;
2 — a table of final uses of goods and services — consumption, capital formation, exports;
3 — a table of primary inputs — labour income, fixed capital consumption, net operating surplus, taxes.
From this table it is easy to establish a simple relationship between primary inputs and final uses.
The total production for all branches G_1 must equal the contribution of domestic output to total resources, i.e. total resources less imported products, that is to say $G_1 = G_2 - M$ where M is total imported products. If the total of intermediate consumption is IC then it follows that

$$G_1 - IC = G_2 - M - IC$$

$G_1 - IC$ represents the total primary inputs of all branches, that is to say wages, capital consumption, taxes, net operating surplus. This amount is the total 'value added by branch'.
$G_2 - IC$ represents total final uses, that is to say private or public consumption, fixed capital or stock investments and exports. $G_2 - IC - M$ represents total final uses less total imports.
Therefore value added, for all the branches, is equal to consumption plus investment plus exports less imports.
The values $G_1 - IC$ or $G_2 - IC - M$ are known as the gross domestic product; one is calculated by adding up the total of primary inputs and the other from the sum of all final uses less imports.
This equation is basic to national income accounting.

(b) The European System of Integrated Economic Accounts (ESA) and the classifications used

The last section introduced various general concepts which must now be clarified, in particular the term 'branch' of production.
The basic concept used for the EUROSTAT input-output tables is the unit of homogeneous production.
The distinguishing feature of the unit of homogeneous production is a unique activity which is identified by its inputs, a particular process of production and its outputs.
The products which constitute the inputs and outputs are themselves distinguished not only by their physical characteristics and their degree of processing but also by the technique of production used. The inputs and outputs can be identified by reference to the classification of products (ESA §265).

The branch consists of a grouping of units of homogeneous production (ESA §268).

The set of activities covered by a branch is identified by reference to a product classification. The branch produces those goods and services specified in the classification, produces all the products specified and only these products.
The input-output tables show the technical or productive aspect of economic structure and do not attempt to describe the financial behaviour of enterprises or other bodies involved in production. In particular the main aim of the tables prepared by the EUROSTAT is to facilitate the comparison of economic structure between the Community countries. The branch of production as defined in the ESA fulfils this requirement.
The basic classification of activities used to classify units of homogeneous production is the NACE (General Industrial Classification of Economic Activities within the European Communities). It is divided into two distinct parts; the first is used for the collection of basic statistics; the second, called the NACE-CLIO, is used for the input-output tables.
The NACE-CLIO is a classification of mutually exclusive activities, each one defined by the products produced. It consists of 186 groups. Each branch of production corresponds to one or several of these groups.
Each group of the NACE-CLIO is defined:
— for goods by the 1971 NIMEXE (Nomenclature of goods for the External Trade Statistics of the Community);

— for services by the list in the section of the NACE concerned with the collection of basic statistics (NACE-GEN).

The content of each of these groups is set out in the provisional publication 'Classification of ESA activities and products'—Statistical Office of the European Communities—May 1971.

The input-output tables for 1970, 1971, 1972, 1973 and 1974 are based on a regrouping of the NACE-CLIO into 44 branches and 7 sub-branches: NACE-CLIO (R 44).

27 of the 44 branches in the NACE-CLIO (R 44) describe the production of goods:

— 1 for agriculture and fishing;
— 5 for fuel and power products;
— 9 for basic materials, metal processing products and transport equipment;
— 11 for other manufacturing products (food products, textiles, paper, etc.);
— 1 for buildings and civil engineering works.

13 branches describe the production of market services:[1]

— 3 for repair services, trade, lodging and catering services;
— 4 for transport and communication services;
— 3 for banking, insurance and renting services;
— 3 for education, health, research and other market services.

4 branches describe the production of non-market services:[1]

— 1 for general administrative services of general government;
— 2 for education, research and health;
— 1 for domestic services.

The input-output table also has rows for 7 sub-branches—3 for energy, 2 for ores and ferrous metals, 2 for transport.

The list of NIMEXE products defining each NACE-CLIO group is available on request.

The list of correspondences between the NACE-CLIO (R 44) and the classifications used for the 1959 and 1965 input-output tables for the Community countries is set out in the Annex.

The following table shows how each branch of the NACE-CLIO (R 44) is broken down into groups.

[1] For a definition of market and non-market services see the European System of Integrated Economic Accounts.

NACE-CLIO (R 44)

Regrouping of the NACE-CLIO groups into branches for establishing the input-output tables 1970, 1971, 1972, 1973, 1974
(44 branches and 7 sub-branches)

NACE-CLIO (R 44) Branches	NACE-CLIO Groups	Description
		Goods
01		*Agricultural, forestry and fishery products*
	011	Vegetable products from agriculture and forests
	012	Wine
	013	Olive oil, unrefined
	014	Animal products from agriculture and hunting
	019	Agricultural products which are exclusively imported
	020	Forestry products
	030	Fishery products
03		*Coal, lignite (brown coal) and briquettes*
	111	Coal and coal briquettes
	112	Lignite (brown coal) and lignite briquettes
05	120	*Products of coking*
07		*Crude petroleum, natural gas and petroleum products*
	130	Crude petroleum, natural gas and bituminous shale
	140	Refined petroleum products
09		*Electric power, gas, steam and water*
	161	Electric power
	162	Gas (distributed by pipes)
	163	Steam, hot water, compressed air
	170	Water (collection, purification, distribution)
11		*Production and processing of radioactive materials and ores*
	151	Ores containing radioactive substances
	152	Production and processing of radioactive materials
13		*Ferrous and non-ferrous ores and metals, other than radioactive*
	211	Iron ore
	212	Non-ferrous metal ores (other than radioactive ores)

NACE-CLIO (R 44) Branches	NACE-CLIO Groups	Description
	221	Pig iron, crude steel, hot rolled and cold rolled sheets, coated metal sheets (ECSC products)
	222	Steel tubes
	223	Extruded and drawn metal, cold-rolled products, cold-formed steel parts and sections
	224	Non-ferrous metals
15		*Non-metallic mineral products*
	231	Gravel, stone, sand and clay
	232	Salts of potassium and of natural phosphates
	233	Rock-salt, marine salt
	239	Other minerals, peat
	241	Bricks and pottery products
	242	Cement, lime, plaster
	243	Building and construction materials made of concrete, cement or plaster
	244	Articles made of asbestos (except for articles made of asbestos-cement)
	245	Stones and other non-metallic mineral products
	246	Millstones and other abrasive products
	247	Glass (plate, hollow, technical, fibre glass)
	248	Ceramic products
17		*Chemical products*
	252	Petrochemical and carbochemical products
	253	Other basic chemical products
	255	Paints, varnishes and printing inks
	256	Other chemical products, mainly for industrial and agricultural purposes
	257	Pharmaceutical products
	258	Soaps, synthetic detergents, perfumes, cosmetics and toilet preparations
	259	Other chemical products mainly for household and office use
	260	Artificial and synthetic fibres
19		*Metal products except machinery and transport equipment*
	311	Foundry products
	312	Metal products which are forged, stamped, embossed or cut
	313	Products of secondary processing of metals
	314	Structural metal products
	315	Products of boilermaking
	316	Tools and finished metal articles, except electrical equipment
21		*Agricultural and industrial machinery*
	321	Agricultural machinery and tractors
	322	Machine tools for metal working, tools and equipment for machinery
	323	Textile machinery and accessories, sewing machines
	324	Machinery for the food and chemical industries; bottling, packaging, wrapping and related machinery; rubber artificial plastics working machinery
	325	Mining equipment, machinery and equipment for metallurgy, for the preparation of building materials, for building and construction, for mechanical handling and lifting
	326	Gears and other transmission equipment
	327	Machinery for working wood, paper, leather and footwear, laundering and dry-cleaning equipment
	328	Other machinery and mechanical equipment
23		*Office and data processing machines; precision and optical instruments*
	330	Office and data processing machines
	371	Measuring, precision and control instruments
	372	Medico-surgical equipment, orthopaedic appliances
	373	Optical instruments and photographic equipment
	374	Clocks and watches
25		*Electrical goods*
	341	Insulated wires and cables
	342	Electric motors, generators, transformers, switches, etc.
	343	Electrical equipment for industrial use, batteries and accumulators
	344	Telecommunications equipment, meters and measuring equipment, electro-medical equipment
	345	Electronic equipment, radio and television receiving sets, sound reproducing and recording equipment, gramophone records and pre-recorded tapes
	346	Electric household appliances
	347	Electric lamps and other forms of electric lighting
27		*Motor vehicles*
	351	Motor vehicles and engines
	352	Bodywork, trailers and caravans

NACE-CLIO (R 44) Branches	NACE-CLIO Groups	Description
	353	Spare parts and accessories for motor vehicles
29		*Other transport equipment*
	361	Boats, steamers, warships, tugs, floating platforms and rigs, materials from the breaking up of boats
	362	Locomotives, other railway and tramway rolling-stock, vans and wagons
	363	Cycles, motorcycles, invalid carriages
	364	Aircraft, helicopters, hovercraft, missiles, space vehicles and other aeronautical equipment
	365	Perambulators, invalid chairs, carts, etc.
31	412	*Meats, meat preparations and preserves, other products from slaughtered animals*
33	413	*Milk and dairy products*
35		*Other food products*
	411	Vegetable and animal oils and fats
	414	Fruit and vegetable preserves and juices
	415	Fish preserves and other sea food for human consumption
	416	Cereals, flour and flakes
	417	Food pastes
	418	Starch and starch products
	419	Bread, rusks, biscuits, cakes and pastries
	420	Sugar
	421	Cocoa, chocolate, sweets, ice-creams
	422	Animal and poultry feedingstuffs
	423	Other food products
37		*Beverages*
	424	Ethyl alcohol from fermented vegetable products and products based on it
	425	Champagne, sparkling wines, wine-based aperitifs
	426	Cider, perry, mead
	427	Malt, beers, brewers' yeast
	428	Mineral waters, soft drinks
39	429	*Tobacco products*
41		*Textiles and clothing*
	431*	Processed textile fibres, products of spinning, thread-making, balling
	432*	Woven and velvet materials
	436	Products of the hosiery trade
	438	Carpets, carpeting, oilcloth, linoleum and other coated fabrics
	439	Other textile products
	453*	Ready-made clothes and clothing accessories
	455	Household linen, bedding, curtains, wall coverings and awnings, sails, flags, bags
	456	Articles of fur
43		*Leathers, leather and skin goods, footwear*
	441	Leathers, skins, hides tanned or otherwise processed
	442	Leather and skin goods
	451*	Footwear, slippers made wholly or partly of leather
45		*Timber, wooden products and furniture*
	461	Sawn, planed, seasoned, steamed wood
	462	Veneered and ply wood, fibre board and particle board, improved and preserved wood
	463	Carpentry, wooden buildings, joinery, parquet flooring
	464	Wooden containers
	465	Wooden articles (other than furniture), sawdust and shavings
	466	Articles of cork, straw, basketware (other than furniture), brooms, brushes
	467	Furniture of wood and cane, mattresses
47		*Paper and printing products*
	471	Wood pulp, paper, board
	472	Products of pulp, paper and board
	473	Products of printing
	474	Products of publishing
49		*Rubber and plastic products*
	481	Rubber products

NACE-CLIO (R 44) Branches	NACE-CLIO Groups	Description
	482	Re-treaded tyres
	483	Plastic products
51		*Other manufacturing products*
	491	Precious and costume jewellery, goldsmiths' and silversmiths' products; working of precious and semi-precious stones; diamond cutting and polishing; striking of coins and medals
	492	Musical instruments
	493	Products for printing and developing cinematographic and photographic films
	494	Games, toys, sports goods
	495	Fountain pens and ballpoint pens, seals, other products n.e.c.
53		*Building and construction*
	505	Construction of dwellings
	506	Non-residential buildings
	507	Civil engineering works
	509	Demolition of buildings
		Market services
55		*Recovery and repair services*
	620	Scrap metals, waste paper, rags, salvage, other products from recovery and demolition
	671	Repair of motor vehicles and bicycles
	672*	Repair of footwear and leather articles, electrical household goods, watches and clocks, jewellery
57		*Wholesale and retail trade*
	610	Wholesale trade
	630	Services of commercial intermediaries
	640	Retail trade
59	660	*Lodging and catering services*
61		*Inland transport services*
	710	Railway transport services and associated services
	721	Local transport services, including underground, railways, tramways and regular bus services
	722	Long distance road transport services for passengers
	723	Long distance road transport services for merchandise
	724	Services of transport by pipelines
	725	Land-borne transport services n.e.c. (funicular railways, cable cars, chair-lifts)
	730	Inland waterways services
63		*Maritime and air transport services*
	741	Maritime transport services
	742	Coastal transport services
	750	Air transport services
65		*Auxiliary transport services*
	761	Services associated with land transport other than railways
	762	Services associated with inland waterways
	763	Services associated with maritime and coastal transport
	764	Services associated with air transport
	771	Services of travel agencies
	772	Services of transport intermediaries
	773	Warehouse and storage services
67	790	*Communication services*
69		*Services of credit and insurance institutions*
	811	Services of central banking authorities
	812	Services of other monetary institutions
	813	Services of other credit institutions
	820	Services of insurance
71		*Business services provided to enterprises*
	830	Services of financial and insurance auxiliaries; real estate; services of lawyers, accountants, tax advisers, management consultants; publicity services; computer and data processing services
	840	Services of renting of movable goods without accompanying personnel
73	850	*Services of renting of immovable goods*

NACE-CLIO (R 44) Branches	NACE-CLIO Groups	Description
75		*Market services of education and research*
	93 C	Market services of education
	94 C	Market services of research and development
77	95 C	*Market services of health*
79		*Recreational and cultural services, personal services, other market services n.e.c.*
	92 C	Market services of refuse disposal, sanitation and cleaning
	96 C	Market services of hostels, professional, economic and employers' associations
	97 C	Market recreational and cultural services
	981	Laundries, dry cleaners and similar services
	982	Hairdressing and beauty salons services
	983	Photographic studios services
	984	Other personal services n.e.c. (funeral services, matrimonial agencies, fortune telling, etc.)
		Non-market services
81		*General public services*
	91	General public services of national defence, of compulsory social security
	92 A	Non-market services of refuse disposal, sanitation, cemeteries, provided by general government
	96 A	Non-market services of social welfare, hostels, tourist offices, employers' and professional associations, economic organizations provided by general government
	97 A	Non-market services of recreational and cultural activities provided by general government (entertainments, sports grounds and clubs, libraries, public archives, museums, botanical and zoological gardens)
85		*Non-market services of education and research provided by general government and private non-profit institutions*
	93 A, B	Non-imarket services of education provided by general government and private non-profit institut ons
	94 A, B	Non-market services of research and development provided by general government and private non-profit institutions
89	95 A, B	*Non-market services of health provided by general government and private non-profit institutions*
93		*Domestic services and other non-market services n.e.c.*
	96 B	Non-market services of social welfare, hostels, tourist offices, trade unions, employers' associations, religious organizations and learned societies, political parties, consumers' and civic organizations etc., provided by private non-profit institutions
	97 B	Non-market services of recreational and cultural activities (entertainments, sports grounds and clubs, libraries, public archives, museums) provided by private non-profit institutions
	99	Domestic services

The input-output table gives, in the rows, the following sub-branches:

NACE-CLIO (R 44) Sub-branches	NACE-CLIO Groups	Description
09.1	161, 163	Electric power, steam, hot water, compressed air
09.3	162	Gas (distributed by pipes)
09.5	170	Water
13.1	211, 221, 222, 223	Ferrous metals and minerals
13.3	212, 224	Non-ferrous metals and minerals
63.1	741, 742	Maritime transport and coastal services
63.3	750	Air transport services

CHAPTER 2

The three series of tables published by the EUROSTAT

The EUROSTAT publication programme for Community input-output tables consists of three series of tables: an annual series from 1970 onwards, five-yearly tables for 1970, 1975, etc. and annual tables at constant prices from 1971.
The annual tables are not as comprehensive as the five-yearly tables because their frequency leaves less time for preparation. The constant price tables are more difficult to draw up than the current annual tables and have been made simpler in form. However the general structure of the tables is the same in all cases, and the balances between the principal aggregates are identical. The definition and composition of each aggregate are to be found in the European System of Integrated Economic Accounts.
Before analysing each series of tables, it is necessary to show how the flows or transactions set out in them are valued.

(a) The valuation of flows in the input-output tables

The flows set out in the tables can be valued in at least three ways. Firstly a flow can be measured when the relevant product leaves the producer unit or enters the country in question, that is at the point of importation—this is the approximate factor price or cif price valuation. Secondly a flow can be valued when taxes levied on the product whether domestically produced or imported have been paid—this is the 'producers' price' or 'ex-customs price' valuation. Thirdly a flow can be valued at the price paid by the purchaser which is the price paid by the final user and equals the sum of the producers' and ex-customs prices plus the cost of distribution and transport.
The approximate factor price valuation is perhaps the one best suited to the form of an input-output table. It gives the most satisfactory measure of the quantities of products consumed and ensures a homogeneous valuation along the rows of the table. If the valuation is made at producers' or ex-customs prices, each flow includes the taxes linked to the product. These taxes vary from branch to branch and thus make comparisons along the rows of a table more difficult.
The valuation at the producers' price is nevertheless useful. The difference between valuation at producers' prices and approximate factor prices gives a clear picture of the effects of indirect taxation. When input-output tables are used to analyse economic structure, the incidence of taxes is very important. The producers' price valuation is also the one more familiar to the producer units and statistical estimates of it are in many cases more reliable.
As a rule only products purchased for final uses are valued at purchasers' prices. The trade and transport margins are then added to the values calculated at producers' prices. Exports are accounted for at fob prices. The advantage of this sort of valuation is that it shows the structure of final uses from the point of view of the final user and not the producer or importer. This is important for the study of consumer behaviour.
The ESA (§626-§638) gives a more detailed description of these valuations.

(b) The annual tables

In the annual tables total purchases of a product are given; the purchases of products are not separated into the outputs of domestic production and imported products. In the columns total intermediate inputs are added to total primary inputs to give domestic production for a branch. In addition to the value of domestic production the value of imports of goods similar to the products of the branch in question are added to give total resources for the branch.
In the annual tables intermediate consumption is valued at producers' prices and final uses at purchasers' prices, with exports being valued at fob prices and imports at ex-customs prices.
Overall a table of this sort is said to be 'at mixed prices'. Total uses equals the addition of two sets of flows calculated in two different ways. The resources include an adjustment row 'trade and transport margins on final uses', which makes it possible to achieve the balance resources/uses for each branch. Along this row, the entry for each branch covers the trade and transport margins on the final uses of products in that branch, while the entire trade and transport margins on final uses are recorded as a negative entry for the branches trade and transport. Thus the total for this row is zero (ESA §638).
Although the valuation system chosen for the annual tables is a compromise it does mean that most of the Community countries can prepare annual tables relatively quickly.

(c) The five-yearly tables

In the five-yearly tables the flows in the table for intermediate consumption and final uses are subdivided so that purchases from domestic production and of imported products can be shown separately. The purchases of

imported products are themselves divided further according to whether they are imported from Community or non-Community countries. This means that each entry in the annual tables, excluding primary inputs, is divided into three elements, domestic production, imports from Community countries, imports from third countries.
This subdivision makes it possible to construct an input-output table for the whole Community by combining the tables for the member countries in a particular way.
The five-yearly tables are prepared following two valuations. For domestic production intermediate consumption is valued at approximate factor prices and producers' prices. Imports are valued at cif prices in the first case and ex-customs prices in the second. The transition from one valuation to another can be made via a matrix of taxes linked to production and to imports, net of subsidies. Final uses are also valued at approximate factor/cif prices and producers'/ex-customs prices.
Finally, total production is calculated at approximate factor prices and producers' prices insofar as intermediate consumption and final uses follow these valuations.

(d) **The constant price tables**

So far it has been assumed that the input-output tables under discussion are valued in the prices of the year to which the tables refer, that is to say at current prices. However for much analysis such a form of valuation is unsatisfactory, particularly when it is necessary to use input-output tables established for different years, to estimate changes in the volume of products purchased and sold, between one year and another.
The most straightforward way of constructing series of input-output tables that enable comparisons of volume movements to be made, is to extend the techniques used to construct the national accounts at constant or base year prices. More exactly the construction of such tables can best be done by means of the methods used to estimate the components of total gross domestic product at constant prices.
To express the uses of g.d.p. for any given year at constant or base year prices a particular base year is chosen and then for each component of total uses, either

(i) a price index for the year in question based on the chosen base year is constructed
or
(ii) an appropriate volume index is constructed.

In the first case the figures at current prices are deflated by the price indices thus giving constant or base year price figures.
In the second case base year figures are multiplied by the volume indices to give constant or base year price figures.
Because of the index number problem these two approaches may not necessarily lead to the same constant price estimate of the components of total uses. However providing the year for which the estimates are made is not too far from the base year, then the difference between these two approaches should not be too great.
The construction of an input-output table at constant prices requires the extension of these techniques to all the additional flows recorded by an input-output table, that is to say, the matrix of intermediate consumption. Although such an extension offers no difficulty in principle, in practice snags may arise because of lack of information for constructing price and volume indices for each of the individual flows. Where it is not possible to calculate specific deflators then general deflators or general volume indices must be used.
Proceeding in this way an input-output table of entries at constant base year prices can be calculated covering final demand and intermediate consumption. It is clearly not straightforward, in theory or in practice, to provide a measure of all the components of value added at constant prices and so as a rule a measure of total value added at constant prices is established by difference. That is to say from total constant price output (given by the row totals of the tables, subrow domestic production) the totals of intermediate purchases at constant prices (the column totals of the matrix of intermediate consumption at constant prices) are subtracted to give the total primary inputs at constant prices.
It should be stressed once again that if a mixture of methods (i) and (ii) is used to express the flows in the table at constant prices, difficulties may arise in balancing the tables.
At present the EUROSTAT is setting up a series of constant price input-output tables for the countries of the Community for the years 1971, 1972, 1973 etc. with 1970 as the chosen base year.

Table showing valuations according to the frequency of the input-output tables

Tables	Valuation		
	Approximate factor prices	Producers'/ex-customs prices	Purchasers' prices
Table of intermediate consumption (T 4.1)	five yearly	annual and five yearly	
Table of final uses (T 4.2)	five yearly	five yearly	annual
Table of primary inputs and resources (T 4.3)	five yearly	annual and five yearly	
Table at constants prices		annual	annual

CHAPTER 3

The arrangement of the tables

The principles underlying the construction of the EUROSTAT input-output tables have been set out in Chapters 1 and 2. The branch and product classification used and the various types of flow evaluation have been defined; the exact form of the tables remains to be discussed.

Both annual and five-yearly tables are divided into three sections: a table of intermediate consumption, a table of primary inputs and a table of final uses. After each of these tables has been examined, the relationships between them will be set down. These relationships vary in points of detail according to the valuation of the tables and therefore according to their frequency. The chapter will conclude with a paragraph on the items in the tables which are not fully explained in the ESA.

(a) The table of intermediate consumption

The table of intermediate consumption forms the central section of the input-output table. The 44 branches of the table which follow the NACE-CLIO classification are set down in the rows and columns. This resulting double-entry table is thus a square table except to the extent that some of the rows are subdivided and correspond to the sub-branches defined on page 12.

The tables for the valuation at both approximate factor prices and producers' prices are set out as follows:

44 branches	01.....93	95
010 930	each entry is subdivided into three components in the five-yearly table	Total intermediate outputs for each product
990	Total intermediate inputs for each branch	*IC*

According to whether the table is read by rows or by columns the flows represent intermediate outputs or intermediate inputs. The total value of intermediate inputs is the same as the total value of intermediate outputs and equals total intermediate consumption (IC). The intermediate consumption of resident producer units represents the value of all goods (other than fixed capital goods) and of all market services consumed during the course of the relevant period in order to produce other goods and services (ESA §320). The elements and expenditures included in intermediate consumption are defined in paragraphs 322 and 323 of the ESA; the elements excluded are defined in paragraph 324.

The subdivision of each flow according to the origin of the product purchased—whether from domestic production, from the EEC or from third countries—means that each entry is divided into three components.

In addition, to provide data for the constant price input-output tables, the last column of the table 'total intermediate outputs for each product' is valued each year at constant prices.

(b) The table of final uses and total uses

In the table of intermediate consumption the entries in the rows provide a detailed picture of the destination of the output of each product. The same is true of the table of final uses—the entries in each row clearly set out the destination of branch output.

It is a double-entry table, and the rows correspond to the branches and sub-branches of the NACE-CLIO classification. The columns divide final uses into the following categories:

01 Final consumption of households on the economic territory
02 Collective consumption of general government
03 Collective consumption of private non-profit institutions
09 Final consumption on the economic territory (01+02+03)
19 Gross fixed capital formation
29 Change in stocks
41 Exports of goods and services to EEC countries
42 Exports of goods and services to third countries
49 Total exports of goods and services (41+42)
89 Final uses (09+19+29+49)
99 Total uses (total intermediate outputs+89)

There are three columns for final consumption on the economic territory. *Final consumption* represents the value of the goods and services used for the direct satisfaction of human wants, whether individual (final consumption of households) or collective (collective consumption

of general governments and private non-profit institutions) (ESA §327).

There are two columns for *gross capital formation* which include respectively gross fixed capital formation and changes in stocks.

Gross fixed capital formation represents the value of durable goods intended for non-military purposes,[1] each of more than about 100 units of account in value, which are required by resident producer units and are meant to be used for a period of more than one year in their processes of production, including the value of any services embodied in the fixed capital goods acquired (ESA §337).

Stocks consist of all goods (raw materials, semi-finished products, work in progress, finished products) other than fixed capital goods, held at a given moment of time by resident producer units. The input-output tables give only the *change in stocks*, calculated from the difference between stocks inputs and outputs during the relevant period (ESA §347).

The third category of final uses is goods and services exported; these are set out in three columns of the table. *Exports of goods* include all goods (new or existing) whether charged for or free, which permanently leave the economic territory of a country for some destination in the rest of the world (ESA §356). They are valued fob (free on board) which corresponds to the market price of the goods at the frontier of the exporting country (ESA §363). This price does not include taxes linked to production for which rebates are granted on goods exported. *Exports of services* include all services (transport, insurance, others) provided by resident units to non-resident units (ESA §365). They are valued in accordance with the ESA §366-372. In the table a distinction is made between exports for the EEC and exports for third countries.

The table of final uses ends with two columns of totals. The first sets down the totals for final uses, the second gives total uses—the sum of intermediate consumption and final uses.

Detailed definitions of each of the final uses are given in §327–374 of the ESA.

Final uses are valued at approximate factor prices and at producers' prices in the five-yearly tables but only at purchasers' prices in the annual tables. For the constant price tables the final consumption of households, collective consumption of general government, collective consumption of private non-profit institutions, gross fixed capital formation, change in stocks and total exports of goods and services are calculated at constant prices. They are prepared annually and valued at purchasers' prices.

[1] Purchases of durable goods for military purposes are considered as the intermediate consumption of general government (see ESA § 323 f).

The table of final uses and total uses is set out as follows:

Final uses / 44 branches	Final consumption				Capital formation		Exports			Final uses	Total uses
	01	02	03	09	19	29	41	42	49	89	99
010											
.											
.											
.											
.											
.											
.											
.											
.											
.											
.											
.											
930											
990 Total											

Finally, as in the table of intermediate consumption, in the five-yearly tables each entry in the rows of the table of final uses is subdivided according to the origin of the product purchased—that is to say from domestic production, from the EEC or from third countries.

(c) The table of primary inputs, resources and total resources

The table of primary inputs and resources is, like the two preceding tables, a double-entry table. The rows set down the values of primary inputs purchased by the branches of production, the total of domestic resources and total resources (domestic resources plus imports). Each of the columns corresponds to one of the branches of NACE-CLIO (R 44). The table is set out as follows:

Code numbers of primary inputs and resources	44 branches / Primary inputs and resources	01.....93	99 Total
010			
.			
.			
.			
.			
.			
.			
.			
.			
.			
.			
.			
970, 980 or 990	Total resources		

Some of the rows in the primary inputs or resources table are peculiar to the valuation chosen for the input-output table as a whole. In the same way, the relationships between the various primary inputs and the resources vary according to the valuation. In the following table, three columns, one for each valuation, show which elements are used for each valuation and the exact relationships between them.

Table of primary inputs, resources and total resources

Description	Annual table		Five-yearly table			
	Mixed prices		Producers' prices Ex-customs prices		Approximate factor prices	
	Row codes					
Gross wages and salaries	010		010		010	
Employers' social contributions	020		020		020	
Net operating surplus	030		030		030	
Net value added at factor cost	070	(010+020+030)	070	(010+020+030)	070	(010+020+030)
Consumption of fixed capital	080		080		080	
Gross value added at factor cost	090	(070+080)	090	(070+080)	090	(070+080)
Taxes linked to production	110		110			
Subsidies	120		120			
Net taxes linked to production	170	(110−120)	170	(110−120)		
Net value added at market prices	180	(070+170)	180	(070+170)		

Table of primary inputs, resources and total resources (continued)

Description	Annual table		Five-yearly table			
	Mixed prices		Producers' prices Ex-customs prices		Approximate factor prices	
	Row codes					
Gross value added at market prices	190	(090+170)	190	(090+170)		
Net taxes linked to production on inputs used					210	
Taxes linked to imports on inputs from EEC countries					220	
Taxes linked to imports on inputs from third countries					230	
Net taxes linked to production and imports, on inputs					270	(210+220+230)
Actual output at approximate factor prices					280	(total intermediate inputs +090+270)
Actual output at producers' prices	290	(total intermediate inputs +190)	290	(total intermediate inputs +190)		
Transfer of ordinary by-products and adjacent products at approximate factor prices	310		310		310	
Transfer of incidental sales at approximate factor prices	330		330		330	
Total transfers at approximate factor prices	390	(310+330)	390	(310+330)	390	(310+330)
Subsidies linked to exports	410		410			
Distributed output at approximate factor prices					480	(280+390)
Distributed output at producers' prices	490	(290+390+410)	490	(290+390+410)		
Imports cif of similar products from EEC countries	510		510		510	
Imports cif of similar products from third countries	520		520		520	
Total imports cif of similar products	590	(510+520)	590	(510+520)	590	(510+520)
Taxes linked to imports of similar products from EEC countries	610		610			
Taxes linked to imports of similar products from third countries	620		620			
Total taxes linked to imports of similar products	690	(610+620)	690	(610+620)		
Imports of similar products from EEC countries at ex-customs prices	710	(510+610)	710	(510+610)		
Imports of similar products from third countries at ex-customs prices	720	(520+620)	720	(520+620)		
Total imports of similar products at ex-customs prices	790	(590+690)	790	(590+690)		
Trade and transport margins on final uses	880					
Total resources at approximate factor prices/cif prices					970	(480+590)
Total resources at producers' prices/ex-customs prices			980	(490+790)		
Total resources at mixed prices	990	(490+790+880)				

Whatever the valuation, gross value added at factor cost is always the same. It consists of the following components:

gross wages and salaries
actual and imputed employers' contributions
net operating surplus
fixed capital consumption

To obtain the gross value added at market prices:

taxes linked to production must be added
and subsidies must be subtracted.

Actual output at approximate factor prices consists of gross value added at factor cost, plus total intermediate inputs, plus those net taxes linked to production and imports, falling on the inputs used.

Actual output at producers' prices includes gross value added at market prices and total intermediate inputs.

Detailed descriptions of the various components of actual output are set out in the ESA. Definitions for the most important components are given below.

The *compensation of employees* includes all payments in cash and in kind made by employers in remuneration for the work done by their employees during the relevant period (ESA §406).

These payments cover:

— gross wages and salaries (ESA §408, 409)
— employers' actual social contributions (ESA §410)
— imputed social contributions (ESA §411–412).

The net operating surplus is the balance of the operating account of the branch. It corresponds to total property and entrepreneurial income derived from productive activity.

Fixed capital consumption is the depreciation of fixed capital during the relevant period as a result of normal wear and obsolescence, including provision for the loss of fixed capital goods as a result of accidental insurable damage (ESA §403).

Taxes linked to production and imports consists of compulsory payments which are levied by general government or by the institutions of the European Communities, on producer units in respect of the production and importation of goods and services or the use of factors of production. These taxes are a component of the producers' price or the ex-customs price; producers are liable to pay them irrespectively of whether or not they operate at a profit (ESA §415–420).

Subsidies are current transfers which general government, or the institutions of the European Communities, make as a matter of economic and social policy to resident units producing goods and market services with the objective of influencing their prices and/or making it possible for factors of production to receive an adequate remuneration (ESA §422–427).

Before actual output can be added to imports to give total resources, adjustments must be made to give *distributed output.*

For each branch, distributed output is equal to actual output plus

— *transfers of ordinary by-products and adjacent products*
— *transfers of incidental sales*

and in the case of distributed output at producers' prices,

— *subsidies linked to exports* must be added.

In the economic system as a whole, the transfers cancel one another out and the total of distributed output of goods services is equal to actual output.

These transfers are entered in such a way that the concept of branch is not changed. In some cases, it is necessary to allocate the output of a branch over several other branches. For details of the treatment of by-products and adjacent products and incidental sales, see ESA §610–616.

Subsidies linked to exports are paid to the branch which distributes the goods and services when they are exported. It is desirable however that the value of the output of these branches be independent of such subsidies. The row in the tables for subsidies on exports sets down the necessary correction. It includes a set of negative adjustments for the distributed outputs of the relevant branches and an offsetting positive entry in the branch for wholesale and trade services etc. The total for the row is zero. This adjustment makes it possible to calculate distributed output net of subsidies on exports.

The following components must be added to distributed output to obtain total resources:

— in the case of the valuation at approximate factor prices, total imports cif of similar products;
— in the case of the valuation at producers'/ex-customs prices, total imports of similar products at ex-customs prices.

For valuation at mixed prices, a row for the trade and transport margins on final uses must be added to balance the input-output table.

Imports of goods include all goods (new or existing), whether charged for or free, which permanently enter into the economic territory of the country having been consigned from the rest of the world (ESA §375).

Imports of services include all services (transport, insurance, for example) provided by non-resident units to resident units (ESA §388).

The cif price (cost, insurance, freight) is the price at which imported products are recorded in the foreign trade statistics. It includes the foreign producers' price, trade margins and the cost of insurance and transport from the place of production to the frontier of the importing country (ESA §631).

The ex-customs price of imported products is the cif price plus taxes linked to imports.

Full detail of the treatment of imported items in the national accounts as well as any conventions used are given in the ESA §375–395.

(d) The general structure of the tables

As the elements which make up the input-output tables have now been discussed at length, the relationships between the three parts of the input-output tables can be presented. These relationships, which depend on the

basic balance between resources and uses, vary according to the valuations and therefore to the frequency of the tables.

(1) *The annual table at current prices*

The balance between resources and uses can be set out as follows:

Resources	Uses
(1) Intermediate inputs at producers' prices	(a) Intermediate outputs at producers' prices
(2) Gross value added at market prices	(b) Final consumption of households, general government and private non-profit institutions at purchasers' prices
(3) Actual output at producers' prices (3) = (1)+(2)	(c) Gross fixed capital formation at purchasers' prices
(4) Transfers	(d) Change in stocks at purchasers' prices
(5) Subsidies linked to exports	(e) Total exports at fob prices
(6) Imports of similar products at ex-customs prices	(f) Final uses at purchasers' prices (f) = (b)+(c)+(d)+(e)
(7) Trade and transport margins on final uses	(g) Total uses at mixed prices (g) = (a)+(f)
(8) Total resources at mixed prices (8) = (3)+(4)+(5)+(6)+(7)	

Clearly the tables of intermediate consumption and primary inputs and resources give the resources side of the picture whereas the tables of intermediate consumption and final uses provide the necessary information for the uses side. Total resources at mixed prices are equal to total uses at mixed prices. To ensure this balance an adjustment row ((7) under the heading resources) is required: trade and transport margins on final uses, defined on page 13 and ESA §638.

(2) *The annual table at constant prices*

The opening part of this chapter outlined the annual tables at current prices showing how the elements are valued at constant prices using 1970 as base year.
For the annual constant price table the details of the uses are complete with the exception of the intermediate transaction table for which only the totals are provided.
The only primary inputs and resources provided at constant prices are the gross value added at market prices, the actual output at producers' prices and the total imports at ex-customs prices.
From these elements, it is possible to balance resources and uses at constant prices in a simpler way than at current prices:

Resources at constant prices	Uses at constant prices
(1) Total intermediate inputs at producers' prices	(a) Total intermediate outputs at producers' prices
(2) Gross value added at market prices	(b) Consumption of households, general government and private non-profit institutions at purchasers' prices
(3) Actual output at producers' prices (3) = (1)+(2)	(c) Gross fixed capital formation at purchasers' prices
(4) Imports of similar products at ex-customs prices	(d) Change in stocks at purchasers' prices
(5) Total resources at mixed prices	(e) Total exports at fob prices
	(f) Final uses at purchasers' prices (f) = (b)+(c)+(d)+(e)
	(g) Total uses at mixed prices (g) = (a)+(f)

As the component transfers and trade and transport margins in the current price table is not available at constant prices, it is not possible to go from total recources at constant prices (5) to actual output (3). The total intermediate inputs at producers' prices are obtained from the difference between actual output (3) and value added (2).

(3) *The five-yearly table*

The five-yearly table provides two balancing relationships where the question of valuation is concerned and three where the origins of the purchases and sales are concerned. Hence the relationships between the tables of intermediate consumption, final uses and primary inputs and resources depend on this multiplicity.

— *The five-yearly table at approximate factor prices*

Briefly (ESA §635), the input-output table at approximate factor prices consists of a table of intermediate consumption and a table of final uses valued without the net taxes levied directly on the products. It is completed with a table of primary inputs and resources in which the taxes linked to production levied directly on the total intermediate inputs of each branch are recorded in the row for taxes.

The balance resources-uses is divided into three parts according to the source of the products or commodities used. The following table shows this breakdown. The source of the flows is either domestic (N), Community (C), or third countries (P). The letter (T) represents the sum of the separate parts (T = N+C+P).

Resources	Uses
(1) Intermediate inputs at approximate factor prices (T, N, C, P)	(a) Intermediate outputs at approximate factor prices (T, N, C, P)
(2) Gross value added at factor cost	(b) Final consumption of households, general government and private non-profit institutions (T, N, C, P)
(3) Taxes linked to production and to imports net of subsidies on the products used	(c) Gross fixed capital formation at approximate factor prices (T, N, C, P)
(4) Actual output at approximate factor prices (4) = (1)+(2)+(3)	(d) Change in stocks at approximate factor prices (T, N, C, P)
(5) Tranfers	(e) Total exports (T, N, C, P)
	(f) Final uses at approximate factor prices (T, N, C, P) (f) = (b)+(c)+(d)+(e)
	(g) Total uses at approximate factor prices (g) = (a)+(f)
(6) Distributed output at approximate factor prices (6) = (4)+(5)	• subrow (N) = distributed output (6)
(7) Imports cif of similar products	• subrows (C) and (P) = imports cif of similar products (7)
(8) Total resources at approximate factor/cif prices (8) = (4)+(5)+(7)	• subrow (T) = total resources (8)

Each element T, N, C and P of the total uses is also to be found under resources. Subrow N of the tables of intermediate consumption and final uses is to be found as a total under distributed output. Subrows C and P are each to be found as totals under imports cif of similar products which are also sub-divided in the table of resources according as to whether they come from Community countries or elsewhere. Finally, the total of N, C and P, which is the sub-row T, the total of intermediate and final uses, corresponds to the total resources at approximate factor/cif prices.

— *The five-yearly table at producers'/ex-customs prices*

Net taxes on inputs used are now included in each intermediate flow. The balance resources-uses can be set out as follows:

Resources	Uses
(1) Intermediate inputs at producers' prices (T, N, C, P)	(a) Intermediate outputs at producers' prices (T, N, C, P)
(2) Gross value added at market prices	(b) Final consumption of households, general government and private non-profit institutions (T, N, C, P)
(3) Actual output at producers' prices (3) = (1)+(2)	(c) Gross fixed capital formation at producers' prices (T, N, C, P)
(4) Tranfers	(d) Change in stocks at producers' prices (T, N, C, P)
(5) Subsidies linked to exports	(e) Total exports (T, N, C, P)
(6) Distributed output at producers' prices (6) = (3)+(4)+(5)	(f) Final uses at producers' prices (T, N, C, P) (f) = (b)+(c)+(d)+(e)
(7) Imports cif of similar products	(g) Total uses at producers' prices (g) = (a)+(f)
(8) Taxes linked to imports of similar products	• subrow (N) = distributed output (6)
(9) Imports of similar products at producers' prices (9) = (7)+(8)	• subrows (C) and (P) = imports of similar products (9)
(10) Total resources at producers'/ex-customs prices	• subrow (T) = total resources (10)

The following four-way balance shows the particular purpose of the five-yearly table:

— total resources	= total uses of flows from all sources
— distributed output	= total uses of flows of domestic origin
— imports of similar products from the Community	= total uses of imported products from Community countries
— imports of similar products from third countries	= total uses of products imported from third countries

Finally, the detailed knowledge of the subdivision of imports as between Community countries and third countries makes it possible to draw up an input-output table for the whole Community.

(e) Additions and comments

As with the Community input-output tables for the year 1965, three items often lead to problems for national accountants and the users of the input-output tables. These are the measurement of the diagonal of the table of intermediate transactions, the introduction of value added tax and subsidies.

(1) *Intrabranch consumption*

Intrabranch consumption appears on the diagonal of the table of intermediate transactions. It excludes subbranches and covers:

— intrabranch imports to obtain the total imports of products;

— purchases and sales between the various NACE-CLIO groups forming the branch of domestically produced products. These groups are listed in chapter 2 in the definition of branches with a 3-figure code;

— the consumption of goods described in the NACE-CLIO for which intragroup consumption is specifically defined. These groups are as follows:

011 Vegetable products from agriculture and forest
111 Coal and coal briquettes
120 Products of coking
140 Refined petroleum products
161 Electric power
242 Cement, lime, plaster
471 Wood pulp, paper, board.

In the case of agriculture this consumption covers the intragroup consumption of cereals, animal and poultry feedingstuffs, plants from seeds, olives for the production of crude olive oil and wine. All re-use within the agricultural sector is considered as intragroup consumption whether or not it has gone through commercial channels and provided that there has been a transaction.

It is easy to assess intragroup consumption in the case of coal, coking, refined petroleum products and cement, lime, plaster. In the case of electric power there are associated services, energy for pumping and losses. Pulp represents intragroup consumption for the group 'Wood pulp, paper, board'.

Finally, for the branch where intrabranch consumption is highest in relation to production 'ferrous and non-ferrous ores and metals, other than radioactive', intrabranch consumption covers the following transactions between NACE-CLIO sub-groups (which is common practice).

— firstly (1) the supply of iron ore (211) to the blast furnaces (part of 221); the supply of pig iron to steelworks is not covered;

(2) the supply of steel for the manufacture of steel tubes (222) and extruded and drawn metal, etc. (223);

— secondly, the supply of non-ferrous metal ores (212) to the non-ferrous metals group (224).

If these principles are applied, there can be no intrabranch consumption for branches 31, 33, 39, 59, 67, 73, 77 and 89.

(2) *The treatment of value added tax*

An appendix to the ESA defines VAT and explains how it is accounted for with particular reference to its treatment in the input-output tables (articles 5–11).

The introduction of VAT in all the Community countries means changing the present method of accounting from a 'gross system' to a 'net system'.

The gross system (present method) means including in the producers' price of each intermediate input the VAT invoiced to the producer on his intermediate inputs. In the table of primary inputs, the row 'net taxes' on outputs includes the VAT payable by the producer on his current output transactions—that is the difference between the VAT invoiced by the producer and the VAT deductible.

The table of primary inputs and resources described in chapter 3 is drawn up on the basis of this principle.

Note:

For the 1975 table and in future, all the Community countries will supply data net of VAT: the net system alone will be used. This means excluding the VAT deductible by the purchaser in the tables of intermediate consumption and final uses. This applies both to domestically produced and imported products. In the table of final uses, the VAT deductible is included neither in exports nor in gross capital formation.

The table of primary inputs will thus show by branch the VAT invoiced by the producer on each product less the VAT deductible by other producers on purchases of the same product, which is equal to the VAT levied on products.

In the table of primary inputs and resources, row 110 thus becomes 'taxes linked to production less the VAT levied on domestically products'. Value added at market prices is given less the VAT levied on the product and the production value is given net of invoiced VAT. Taxes linked to imports are supplied less the VAT levied on imported products and imports at ex-customs prices are thus valued net of VAT.

In order to ensure the balance between uses and resources, the table of primary inputs and resources of the input-output table includes an additional row (870) corresponding to all VAT levied on domestically produced and imported products (except for the valuation at approximate factor prices).

(3) *Subsidies*

Subsidies, including those on exports are defined on page 19. The problem which arises in recording them is that they are difficult to distinguish in relation to other flows which can be:

— negative taxes linked to production such as the reduction of tax on fuels or tax rebates on exports;

— transfers such as accident insurance contributions or reduced rates on the railways;

— investment grants such as those awarded to the railways.

The definition is linked to market and non-market services.

If the service is considered as a market service, the payment made by general governments is entered as a subsidy.

If the service is considered as a non-market service, the payment made by general government is entered as a transfer and is included under either collective consump-

tion of private non-profit institutions or final consumption of households.

The ESA defines subsidies it but is also necessary to determine which branch receives the subsidy.

In the case of a direct subsidy from general government to a branch, there is no problem and this subsidy determines the output of the branch at producers' prices. Exceptions to this simple case are subsidies passed on by national intermediary bodies (national marketing organizations), as is the case with agricultural products purchased by bodies of this kind and sold at lower prices. In the interest of the balance between resources and uses, it is better to enter these under the branch concerned—in this case, agriculture, by adjusting the values of the exports and purchases of the user branches. Perhaps a satisfactory solution for the future would be to enter these subsidies in a separate row in the table of primary inputs so that they do not affect the production value and even adjust the value of the total resources.

CHAPTER 4

The use of the input-output tables

Input-output tables provide a framework for setting down an extensive range of national accounts data where the balance between resources and uses is clearly shown. Because these data are so numerous, when the flows are expressed in monetary values, the tables form a rather unwieldy tool for economic analysis. To make this mass of information more manageable it is useful to derive tables of coefficients and multipliers from the basic tables and to use econometric methods in their analysis.

The various ways of using the input-output tables to be examined in this chapter, focus upon the analysis of the interdependence of the branches starting from the algebraic form of the balances described in Chapter 3. Although a detailed discussion of the use of input-output tables for cross-sectional analysis, long-term forecasting, statistical studies of the environment, etc. falls outside the scope of this methodology, nonetheless the developments set out below do serve as a general basis for such studies.

After the definition of the notation used to describe the tables their elements and various mathematical operations, there are three sections. The first section explains how the fundamental balancing relationships are derived distinguishing both horizontal and vertical coefficients. In addition, the importance to structural analysis of direct and indirect coefficients and dispersion multipliers is also shown. The fundamental balancing relationships are used in the second section to provide some examples of how structural analysis can proceed. Finally, the third section is devoted to analysis of the effects of output price variations, and changes in input costs, on production and final uses.

NOTATION

(1) *General description of the tables*

The form of the tables varies according to whether they are annual or five-yearly. The most general and complete set of balances between uses and resources is provided by the five-yearly table valued at producers' prices. The annual table provides a partial summary of these balances with the added difficulty of a separate valuation for final uses. The five-yearly table at approximate factor prices can be obtained from the five-yearly table at producers' prices provided a matrix of taxes is available. The results for the table at producers' prices still apply to the table at approximate factor prices given an adjustment for the taxes involved.

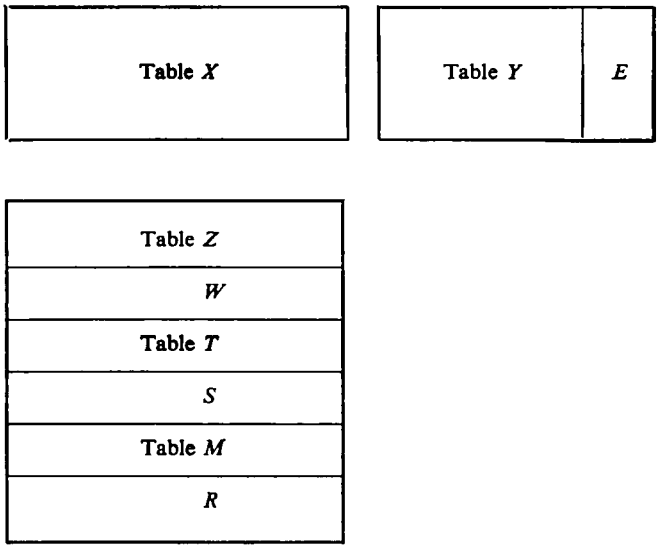
Finally, since the constant price tables are not provided to the same level of detail as the other tables, the balances set out in Chapter 3 cannot be completely satisfied in this case. The constant price table is, however, of importance for the comparison of flows for different time periods; a natural development from the current-price tables.

Thus, unless otherwise stated, the details given in the three sections of this chapter refer to the five-yearly table at producers' prices.

As a starting point, since the uses-resources balance differs according to the source of the flows or purchases, the elements in the five-yearly table must be differentiated by means of a subscript. Flows of domestically-produced goods and services are subscripted by the letter d and flows of imports by the letter m. The letter t represents total flows. Thus, if X is the matrix giving an overall view of the table of intermediate consumption, X_t represents total intermediate inputs so that:

$$X_t = X_d + X_m$$

The general plan is as follows:



where

— X is the square matrix of the values in national monetary units of flows of intermediate consumption. This matrix does not include a final row and column of totals which sum the inputs and the outputs. If the table is drawn up from the basic classification in 44 branches, the dimension of X is 44×44.

— Y is the rectangular matrix of the values in national monetary units of final uses. It covers 44 rows in the basic classification and 7 columns.
— E is the vector representing total uses: it has 44 elements.
— Z is the rectangular matrix of primary inputs expressed in national currency. It has 44 columns in the basic classification. The number of rows varies according to the valuation. For the valuation at producers' prices, the rows consist of the six components of gross value added at market prices. For the valuation at approximate factor prices, they consist of the components of actual output.
— W is the vector representing actual output: it consists of 44 elements.
— T is a matrix representing transfers and, where they exist, subsidies linked to exports.
— S is the vector representing distributed output: it has 44 elements.
— M is the matrix for imports of similar products. These imports are valued cif or at producers' prices according to whether the taxes linked to imports are included in the flows or not.
— R is the vector representing total resources: it has 44 elements.

(2) *Algebraic presentation*

(a) Any vector: E, R, W, etc. is always considered to be a column vector.
(b) X' is the transposed matrix of X which changes the rows of X into the columns of X' and the columns of X into the rows of X'.
E' is the transposed row vector corresponding to E; R' is the transposed row vector corresponding to R, etc.
(c) I is the unit matrix.
(d) X^{-1} is the inverse matrix of X provided it exists:

$$X^{-1}X = XX^{-1} = I$$

(e) $\hat{W}$ is a diagonal matrix, that is to say all its elements are zero except those in the diagonal which is composed of elements of the vector W. This transformation can be made for any vector.
(f) U is the unit vector, all the elements of which are equal to 1; thus XU is a column vector the elements of which are the sums of the elements of the rows of matrix X, and $U'X$ is a row vector the elements of which are the sums of the elements of the columns in matrix X.

Section I

THE FUNDAMENTAL BALANCING RELATIONSHIPS

The general balancing properties of an input-output table have been described at length in chapters 1 and 3 of the methodology. To meet the requirements of economic analysis, they now need to be put into mathematical form.
Using the notations described above, the sum of intermediate consumption and final uses equals total uses E_t so that:

$$E_t = X_tU + Y_tU \qquad (1)$$

and

$$E_d = X_dU + Y_dU$$

and

$$E_m = X_mU + Y_mU$$

The sum of the total intermediate inputs, primary inputs, transfers and imports equals total resources R so that:

$$R = X_t'U + Z'U + T'U + M'U \qquad (2)$$

From these simple equations, obtained by adding the elements in the input-output table, once horizontally and once vertically, it is possible to find two balancing relationships. The first links production to final uses and the second links uses to primary inputs.

(a) The vertical balance

Distributed output S is defined by:

$$S = X_t'U + Z'U + T'U$$

This expression, using equation (2) gives:

$$R = S + M'U \qquad (3)$$

Total uses equal total resources:

$$E_t = R$$

and the balance can be expressed, using (1) and (3) as:

$$X_tU + Y_tU = S + M'U$$

Distributed output is thus obtained from uses and imports by means of the following equation:

$$S = X_tU + Y_tU - M'U \qquad (4)$$

This equation also shows how distributed output equals the sum of uses less imports. It can also be written as:

$$S = X_dU + Y_dU \qquad (4bis)$$

because $$M'U = X_mU + Y_mU$$

It is now useful to introduce a simple hypothesis into the analysis: suppose that the production processes described by the columns of the matrices X and Z exhibit constant returns to scale. In other words, a change in the output of a branch is offset by an equivalent change in the intermediate and primary inputs.
This hypothesis can be expressed in matrix form by introducing an array of coefficients A so that:

$$X_t = A\hat{W} \qquad (5)$$

Matrix A is called a matrix of direct vertical coefficients or technical coefficients. It expresses the relationship

of each input element in a branch to the actual output of that branch.

Actual output W is linked to distributed output S by the amount of transfers made:

$$S = W + T'U \tag{6}$$

Equations (4) and (6) give:

$$X_t U + Y_t U - M'U = W + T'U$$

and, by replacing X_t by its value in (5),

$$AW + Y_t U - M'U = W + T'U$$

whence the value of the actual output is:

$$\boxed{W = (I-A)^{-1}(Y_t U - M'U - T'U)} \tag{7}$$

Equation (7) links final uses Y_t to actual output W via a system of coefficients, the elements of matrix $(I-A)^{-1}$. This matrix, which is very important for input-output analyses, is called a matrix of direct and indirect coefficients. It also has important mathematical properties.

Each element in the matrix of direct coefficients A is positive and less than unity. The sum of the elements in a column is also less than unity. It is thus possible to show that

$$(I-A)^{-1} = I + A + A^2 + A^3 + \ldots$$

which, applied to equation (7), gives:

$$W = (I + A + A^2 + A^3 + \ldots)(Y_t U - M'U - T'U)$$

or

$$W = (Y_t U - M'U - T'U) + A(Y_t U - M'U - T'U) + A^2(Y_t U - M'U - T'U) + \ldots$$

This equation shows that actual output W is equal to final uses $(YU - M'U - T'U)$ plus the intermediate inputs necessary to meet these final uses $A(Y_t U - M'U - T'U)$, plus the intermediate inputs necessary to produce the preceding intermediate inputs $A^2(Y_t U - M'U - T'U)$ etc. Matrix $(I-A)^{-1}$ shows the direct effects $(Y_t U - M'U - T'U)$ and the indirect effects $A(Y_t U - M'U - T'U) + A^2(Y_t U - M'U - T'U) + \ldots$ on actual output, of a given level of final demand $(Y_t U - M'U - T'U)$.

The vertical balance of equation (7) applies to both the total of final uses $Y_t U$ and its components: that is to say final consumption of households, collective consumption of general government and private non-profit institutions, capital formation and exports. In other words, from $Y_{1t}, Y_{2t}, Y_{3t}, \ldots$ the components of final demand, actual output may be written as

$$W = (I-A)^{-1} Y_{1t} + (I-A)^{-1} Y_{2t} + (I-A)^{-1} Y_{3t} + \ldots - (I-A)^{-1}(M'U + T'U)$$

The values $(I-A)^{-1} Y_{1t}$, $(I-A)^{-1} Y_{2t} \ldots$ measure the direct and indirect contributions of the components of final uses to actual output.

(b) **The horizontal balance**

Returning to the values of total uses and total resources as set out at the beginning of this section, the general balance of the input-output table shows:

$$E_t' = R' = U'X_t + U'Z + U'T + U'M \tag{8}$$

From the table of intermediate consumption X_t, it is possible to define a coefficient B so that:

$$X_t = \hat{E}_t B \tag{9}$$

which is a matrix algebra formulation of the assumption that the proportions in which a given product satisfies the intermediate consumption of the various branches, or final uses, are independent of the level of total use of the product.

Matrix B is called a matrix of direct horizontal coefficients or distribution coefficients. It expresses the relationship of each element in the row for a branch to the total uses of products of the branch.

By putting the value of X given in equation (9) into equation (8), then:

$$E_t' = E_t' B + U'Z + U'T + U'M$$

or

$$\boxed{E' = (U'Z + U'T + U'M)(I-B)^{-1}} \tag{10}$$

Equation (10) links primary inputs Z to total intermediate and final uses, E', via a system of coefficients, the elements of the matrix $(I-B)^{-1}$.

Matrix $(I-B)^{-1}$ has similar mathematical properties to the matrix $(I-A)^{-1}$ and can be expressed in the form:

$$(I-B)^{-1} = I + B + B^2 + B^3 + \ldots$$

showing that total uses E_t' equals the value of primary inputs, transfers, and imports $(U'Z + U'T + U'M)$ plus the value of the primary inputs, transfers, and imports, incorporated in the inputs of the branches:

$$B(U'Z + U'T + U'M) + B^2(U'Z + U'T + U'M) + \ldots$$

Equation (10) thus makes it possible to break down the total use of the products in each branch into their direct and indirect primary input, transfer and import contents. The horizontal balance, equation (10), applies to both total primary inputs $U'Z$ and its components: gross wages and salaries, social contributions, net operating surplus, fixed capital consumption, taxes linked to production, and subsidies. It is thus possible to measure the direct and indirect contribution of each primary input to total uses. Section II of this chapter shows the practical application of calculations of this sort.

(c) **The use of direct and indirect coefficients in economic analysis**

The matrices of coefficients A and B are basic to the analysis of relationships between branches because they make it possible to eliminate the effects of scale when comparisons are made: they are calculated as the ratio of

values which are themselves at least in theory the result of the multiplication of a quantity by a unit price.
The matrix of coefficients A shows the structure of the production costs of the branches; it is, for this reason, called a matrix of technical coefficients. The matrix of coefficients B shows the structure of the use of the products of a branch by other branches, hence its name—the matrix of distribution coefficients. Two further hypotheses frequently made, which are essential to the establishment of input-output models are, firstly, the stability in time of the technical coefficients and, secondly, the stability of the distribution coefficients when the relative prices of the products of the branches change. Other hypotheses are sometimes possible: the substitution of inputs in response to price movements at a certain rate, the non-linear distribution of price increases across the purchasing branches etc.
The choice of a vertical or horizontal balance depends entirely on the relevance of one or other of these hypotheses to the case under consideration.
The transformation from matrix A to matrix B is straightforward; if the equations A and B are combined:

$$X_t = A\hat{W} = \hat{E}_t B$$

so that

$$\boxed{A = \hat{E}_t B \hat{W}^{-1}}$$

For flows of domestic origin, this equation is particularly important. From the defining equations

$$X_d = A_d \hat{W} = \hat{E}_d B$$

or

$$A_d = \hat{E}_d B_d \hat{W}^{-1}$$

As E_d is equal to distributed output:

$$\boxed{A_d = \hat{S} B_d \hat{W}^{-1}}$$

The inverse matrices $(I-A)^{-1}$ and $(I-B)^{-1}$ show the interdependence of the branches better than the direct coefficient matrices. Each element of these matrices depends upon the whole or a sub-set of the elements of A and of B. An element situated at the intersection of line i and column j in matrix $(I-A)^{-1}$ shows the value of the inputs of product i directly and indirectly required so that branch j can satisfy a final demand of unit value.
The same element of matrix $(I-B)^{-1}$ shows the value of the uses of products i directly and indirectly required by branch j if the value of the primary inputs of the branch i is one unit.
The sums of the rows and columns of matrices $(I-A)^{-1}$ and $(I-B)^{-1}$ provide economic multipliers which are very helpful in analysis:

— for $(I-A)^{-1}$, the horizontal sum is known as the *sensibility of dispersion:* it gives the multiplicative effect of unit final demand of all the branches, on the production of a branch. The vertical sum is known as the *power of dispersion:* it gives the multiplicative effect of unit final uses of a branch, on the production of all the branches.

— for $(I-B)^{-1}$, the horizontal sum is known as the *power of dispersion:* it gives the multiplicative effect of unit primary input of a branch on the total resources of all the branches. The vertical sum is known as the *sensibility of dispersion:* it gives the multiplicative effect of unit primary inputs of all the branches on the total resources of one branch.

It must, however, be remembered that equations (7) and (10) and the examples in the following sections are concerned with linear relationships. Calculations such as direct and indirect requirements for primary inputs, the direct and indirect content of primary inputs per category of final uses and the direct and indirect content of imports for both intermediate and final uses depend on this linearity.

Section II

EXAMPLES OF HOW INPUT-OUTPUT TABLES PROVIDE A FRAMEWORK FOR THE ANALYSIS OF ECONOMIC STRUCTURE

Since the most important data needed for the equations derived in the preceding section are available for one country or a group of countries, it is interesting to use them immediately in one or two simple examples. The outlines which follow make possible an initial simple analysis which can then serve as the basis for more detailed work.
In order to avoid mathematical repetition, reference will only be made to the vertical balance based upon the matrix of vertical coefficients A. If the use of the matrix of horizontal coefficients B is more appropriate to the problem in question, the results must be reestablished on the basis of the hypotheses used to establish the horizontal balance.
In what follows the inverse matrix has been calculated for the matrix of flows of domestic origin. This provides a useful picture of the actual intersectorial relationships in the country or group of countries under consideration. The vertical coefficient used is thus no longer a complete technical coefficient because, for each entry, the proportion of the product imported is not included. Imports will thus have to be studied separately.
The section is divided into two parts. The first explains the link between primary inputs and final uses. The second paragraph shows the proportion of imports in final uses.

(a) Primary inputs and final uses

Primary inputs and final uses can be linked by two simple applications of the properties of the inverse matrix of vertical coefficients:
— the calculation of direct and indirect primary input requirements per 1000 units of final uses;
— the calculation of the direct and indirect primary input contents per category of final uses.

(1) *Direct and indirect primary input requirements per 1000 units of final uses*

The primary inputs used are those in table Z. For the valuation at approximate factor prices, taxes on inputs used replace the taxes linked to production, of the valuation at producers' prices. In the 'net system' of VAT valuation, the latter can be included in the matrix Z.

From the matrix Z, it is possible to calculate a matrix A_z, the elements of which are formed from the ratio of each element in the columns of Z to the corresponding element in the vector W, that is to say actual output:

$$Z = A_z \hat{W}$$

Matrix A_z gives the proportion of primary inputs for production to each branch.

The direct and indirect requirements for primary inputs per 1000 units of final uses for the products of the branches are then expressed in the form:

$$K_z = A_z(I - A_d)^{-1}$$

and the elements of A_z are expressed as thousandths of the actual output W.

A branch is not only a user of primary inputs by virtue of its direct requirements (columns of the matrix A_z), but also it uses primary inputs as a result of its purchases of products as inputs. These primary inputs form the indirect requirements; they are equal to the difference between the elements of K_z and those of A_z.

A useful indicator can be found from the matrix K_z: the total direct and indirect requirements of all the branches for each of the primary inputs per 1000 units of final uses. This is obtained from the sum of the elements of a row of K_z divided by the number of branches in the table. As it is an average, an initial classification of branches according to their primary input requirements is possible.

(2) *Direct and indirect primary input content per category of final uses*

The vector Y_d represents final uses of domestically-produced products and total final uses is made up of the sum of these uses by branch. From the coefficients calculated for the vertical model, it is easy to obtain the distribution by final use of the primary input requirements. This involves applying to each row of Y_d the coefficient expressing the primary input requirements of each branch.

If k_i is a row of K_z where the subscript i indicates the ith primary input. If y_j is a row of Y_d where the subscript j indicates the jth branch of the table. In order to obtain for the ith primary input the direct and indirect content of category f of final uses, it is necessary to calculate the products

$$k_{ij} \cdot y_{jf}$$

and then to vary f, j and i in that order.

A set of tables can then be set up, one for each category of primary input, the columns of which will refer to categories of final uses. The elements of the tables obtained are monetary values. If the primary input selected is 'gross wages and salaries' the final use selected consumption of households and the branch concerned textiles, a table of this sort will supply, for example, the direct and indirect gross wages and salaries content of the final textile consumption of households.

The sum of the elements of one column of a table gives the total content of a final use of a given primary input. The relationship between the content per branch and the total content expressed as parts of a thousand is a useful ratio; it shows the relative importance of wages, taxes, fixed capital formation, etc. for each final use by branch.

(b) Imports and final uses

Two other simple applications of the properties of the inverse matrix of vertical coefficients link imports and final demand:

— the calculation of the direct and indirect import requirements per 1000 units of final uses;

— the calculation of the direct and indirect import content per category of final uses.

As indicated at the beginning of the chapter, the applications dealt with here relate to the five-yearly table. The matrices of inputs are available for intermediate consumption and final uses. This does not mean however that the system outlined, based upon domestic flows, cannot usefully be applied to the annual tables for the intervening years. In fact, for these years, the total imports of similar products can be distributed according to purchasing branch or final use, either by using the ratio of total uses of imported goods per branch to total uses or by extrapolating the allocation of imports from the last five-yearly table.

(1) *Direct and indirect import requirements per 1000 units of final uses*

For each flow of intermediate inputs or final uses, the total flow of imports is known as well as whether it comes from the Community or from third countries. From these data, the vertical coefficients A_m can be defined as parts of a thousand as follows:

$$X_m = A_m \hat{W}$$

where X_m is a matrix for the total flows of imports which can easily be broken down according to their Community or non-Community origin.

Taking the vertical balance from the preceding section, the direct and indirect import requirements per 1000 units of final uses for products in a given branch can be expressed in the form:

$$L_m = A_m(I - A_d)^{-1}$$

where L_m is a matrix in which the elements placed at the intersection of row i and column j indicate the direct and indirect requirements of the branch j for product i imported in order to supply 1000 units of products j of domestic origin for final uses.

These coefficients indicate the degree of dependence of a branch on external sources of supply not only through its direct imports but through the imported content of the domestically-produced products which it uses.

For structural comparison, it is useful to calculate the totals of each row of L_m divided by the number of branches. This shows the direct and indirect requirements of all the branches per 1000 units of final demand. The requirements of each branch are shown in relation to the average.

Once the direct import requirements given by A_m are known, the indirect requirements can be obtained from the difference between this and L_m. It is also useful, for certain analyses, to calculate a matrix of intermediate inputs and final uses 'less direct and indirect imports'.

(2) *Direct and indirect import content by category of final uses*

The application of the direct and indirect import coefficients given by matrix L_m to the table Y_d of final uses of domestically-produced products is expressed in the form:

$$L_m \cdot Y_d$$

The elements in this matrix are monetary values which express the direct and indirect import content of the products of each branch purchased by the various categories of final uses. This content should not be confused with the amount of imported products which are not involved in intermediate transactions and are used immediately for final uses. These imports amount to the difference between Y_t and Y_d and should be added to the preceding content if the part played by imports in total final uses is to be considered.

Another useful ratio is the sum for each final use of the import content of products purchased of each branch, divided by the number of branches. It facilitates comparison of the average imports in each final use.

General comment

In the vertical balance (7), the imports of similar products (M) and transfers (T) appear together with final uses in the second part of the equation.

When the flows used to calculate the vertical coefficients and the table of final uses are those of domestic origin only then the adjustment $M'U$ is not necessary. Nevertheless, for any economic interpretation of the preceding equations, particular attention should be given to branches with sizable transfers.

Section III

ANALYSIS OF THE EFFECTS OF OUTPUT PRICE VARIATIONS AND CHANGES IN INPUT COSTS

To enable such analysis to be done the equations set out in section I must be modified to allow for separate price and volume movements; in particular the coefficient matrices must be redefined so that each coefficient equals the *volume* of input per unit of the *volume* of output, rather than the *value* of an input per unit of the *value* of output, as was the case in section I.

The practical means for carrying out this analysis is to use constant price input-output tables. The starting point is the two fundamental equations

$$X_d U + Y_d U = S = T'U + W \qquad (1)$$

horizontal balance

and

$$U'X_d + U'X_m + U'Z = W' \qquad (2)$$

vertical balance

Actual output W can be separated into a price component P and a quantity component Q in the form:

$$W = \hat{P}\,Q$$

The new coefficient matrix A_d can be defined as:

$$X_d = \hat{P}\,A_d\,\hat{Q}$$

and the coefficient matrix B_d as:

$$X_d = \hat{P}\,\hat{Q}\,B_d$$

A matrix of coefficients derived from imports can be expressed in the form:

$$X_m = \hat{P}_m\,A_m\,\hat{Q}$$

and for primary inputs:

$$Z = D\,\hat{Q}$$

By substituting these new values in equation (1) then:

$$\hat{P}\,A_d\,Q + Y_d U = T'U + W$$
$$\hat{P}\,A_d\,Q + Y_d U = T'U + \hat{P}Q$$

hence

$$Q = (I - A_d)^{-1}\,\hat{P}^{-1}(Y_d U - T'U) \qquad (3)$$

Equation (3) shows the relationship between the volume of production Q and final uses expressed at base year prices

$$\hat{P}^{-1}(Y_d U - T'U)$$

via the matrix of technical coefficients A_d.

In the case of the vertical balance, the use of the matrices of coefficients gives the following equation:

$$P'A_d\hat{Q} + P'_m\,A_m\,\hat{Q} + U'D\hat{Q} = P'\hat{Q}$$

Eliminating matrix $\hat{Q}$ leads to an equation linking prices P,

costs of primary inputs $U'D$ and structural matrices A_d and A_m:

$$P'A_d + P'_mA_m + U'D = P'$$

or:

$$\boxed{P' = (P'_mA_m + U'D)(I-A_d)^{-1}} \quad (4)$$

This equation makes it possible to study the effects of price changes and of changes in the use of primary inputs. It will be used either in the above form or in a form modified by the introduction of simple hypotheses.

Two distinct types of problem arise:

(a) If P is a price vector, it is not difficult to examine the effects of an increase in any one of the n prices on the remaining $n-1$ prices. More generally, it is possible to examine the effect of increasing m out of n prices ($m<n$), on the $n-m$ remaining prices.

(b) Equation (4) can be used to study the effects of a partial or general increase in the cost of primary inputs on all the prices P.

Problems (a) and (b) can of course be considered together.

Firstly, consider problem (a) and equation 4:

$$P'A_d + P'_mA_m + U'D = P'$$

where to simplify matters it is possible to set

$$P'_mA_m = N'.$$

Consider the division of vectors P' and N' and matrices A_d and D into elements of dimension n_1 and n_2 so that $n_1+n_2=n$.

Thus:

$$P' = [P'_1P'_2] \qquad N' = [N'_1N'_2]$$

$$A_d = \begin{bmatrix} A_{d11}A_{d12} \\ - - - - - \\ A_{d21}A_{d22} \end{bmatrix} \qquad D = [D_1D_2]$$

where A_{d11} has n_1 rows and n_1 columns, A_{d12} has n_1 rows and n_2 columns, A_{d21} has n_2 rows and n_1 columns and A_{d22} has n_2 rows and n_2 columns.

On the basis of this subdivision, two equations can be established:

$$P'_1A_{d11} + P'_2A_{d21} + N'_1 + U'D_1 = P'_1$$
$$P'_1A_{d12} + P'_2A_{d22} + N'_2 + U'D_2 = P'_2$$

The first equation can be expressed as:

$$P'_1 = (N'_1 + U'D_1)(I-A_{d11})^{-1} + P'_2A_{d21}(I-A_{d11})^{-1} \quad (5)$$

This equation shows how prices P'_1 depend on primary inputs $(N'_1+U'D_1)$ and the other prices in the system P'_2. It is thus possible to show the effect of an increase in the set of prices P'_2 on the set of prices P'_1, given the primary inputs. Any change in prices has an effect on P'_1 through the matrix multiplier $(I-A_{d11})^{-1}$. The interpretation of this multiplier is given in the first part of this chapter.

Differentiation of equation (5) with respect to price changes only, gives

$$\delta P'_1 = \delta P'_2A_{d21}(I-A_{d11})^{-1} \quad (6)$$

which shows how the initial price movement $\delta P'_2$ is dispersed over all the other prices in the group $\delta P'_1$, under the effect of the matrix multiplier $A_{d21}(I-A_{d11})^{-1}$.

Now consider problem (b), the effect on prices of an increase in the cost of primary inputs.

First remember that D_1 is a matrix of coefficients giving the unit cost of the primary inputs in the formation of each price P_1. Each row in the matrix D_1 refers to a specific primary input: gross wages and salaries, operating surplus, taxes linked to production, etc.

If $d_1, \ldots, d_k$ are the rows of D_1, equation (5) can be expressed in the form:

$$P'_1 = [N'_1 + d_1 + \ldots + d_k](I-A_{d11})^{-1} + P'_2A_{d21}(I-A_{d11})^{-1}$$

Ignoring price movement a variation in the level of primary input d_j has the following effect on prices:

$$\delta P'_1 = \delta d_j(I-A_{d11})^{-1} \quad (7)$$

It is possible to combine equations (6) and (7) so that simultaneous variations in price and primary inputs can be considered.

As n_1 can take all possible values from 1 to n, equation (7) takes for $n_1 = n$ the form:

$$\delta P' = \delta d_j(I-A_d)^{-1}$$

These simple equations can be made more general. The following example shows the possibilities that exist.

Suppose that the kth row of matrix D_1, or d_k, represents taxes linked to production by producer unit. Suppose also that these taxes are ad-valorem and are proportional to a general tax rate e_k so that:

$$d_k = e_kP'_1$$

it is possible to introduce the value d_k into the equation:

$$P'_1A_{d11} + P'_2A_{d21} + N'_1 + d_1 + \ldots + d_k = P'_1$$

so that

$$P'_1 = (N'_1 + d_1 + \ldots + d_{k-1})(I-A_{d11}-e_k)^{-1} + P'_2A_{d21}(I-A_{d11}-e_k)^{-1} \quad (8)$$

in this case the effect of a variation in prices P'_2 is expressed as

$$\delta P'_1 = \delta P'_2A_{d21}(I-A_{d11}-e_k)^{-1} \quad (9)$$

and the effect of a variation in primary inputs is expressed as

$$\delta P'_1 = \delta d_j(I-A_{d11}-e_k)^{-1} \quad (10)$$

the effect of the two movements taken together is obtained by combining equations (9) and (10).

Conclusion

This methodology by no means represents an exhaustive study of the application of input-output tables to economic problems.

It has been drawn up, following the ESA, firstly as an aid to understanding the input-output tables published by the Statistical Office of the European Communities but, above all, to ensure that the tables are able to give the reader a simple and clear picture of basic economic interdependence, making it possible to compare the economic systems of the Community countries, to understand the structural differences between them and to study their origins.

Annex

Correspondence between the classifications used by the Statistical Office of the European Communities to draw up the input-output tables for 1959, 1965, 1970 et seq.

ANNEX

This annex sets out the correspondence between the NACE-CLIO (R 44) and the classifications used to draw up the 1965 and 1959 input-output tables for the Community countries. In 1959 and 1965, an aggregate classification divided into 37 and 56 branches respectively had been drawn up to ensure that the tables were comparable between countries and to make it possible to establish a table for the whole Community. These aggregate classifications were drawn from the original tables which were based upon 65 branches for 1959 and 90 branches for 1965. They are shown in the following correspondence table.

For many branches there is a clear connection between the NACE-CLIO groups forming the branches in the tables for the years 1970 and 1965.

The EUROSTAT has a tape file of a harmonized version in 44 branches of the tables for the three years with, however, a different 1959 table for the Federal Republic of Germany.

Correspondence between the NACE-CLIO (R 44) and the classifications used to draw up the 1965 and 1959 input-output tables for the Community countries

1970		1965		1959		Comments
NACE/CLIO (R 44) Branches and sub-branches	NACE/CLIO Groups	90 br.	56 br.	65 br.	37 br.	
01	011	010	010	01	01	
	012					
	013					
	014					
	019					
	020					
	030	030	030	02	01	
03	111	110	110*	03	02	Branch 110 (1965 — 56 br.) is common to 03 and 05 of R 44
	112					
05	120	120	110*	04	03	
07	130	130	130	07	05 A	
	140	140		32	05 B	
09	161	161	161	53	28 A	
	162	162		54	28 B	
	163	163				
	170					
09.1	161, 163	161, 163		53, 54	28 A, B	
09.3	162	162		54	28 B	
09.5	170	163			28 B	
11	151	212*	211*	06*	04*	Branches: 212 (1965 — 90 br.) 211 (1965 — 56 br.) 224 (1965 — 90 br. — 56 br.) 06 (1959 — 65 br.) 04 (1959 — 37 br.) 37 (1959 — 65 br.) 21 (1959 - 37 br.) are common to 11 and 13 of R 44 Branch 20 (1959 — 37 br.) is common to 13 and 19 of R 44
	152	224*	224*	37*	21*	
13	211	211	211*	05	04*	
	212	212*	211*	06*	04*	
	221	221	222	35	19	
	222	222		35, 36	19, 20*	
	223					
	224	224*	224*	37*	21*	
13.1	211, 221, 222, 223	211, 221, 222	211*, 222	05, 35, 36	04*, 19, 20*	
13.3	212, 224	212*, 224*	211*, 224*	06*,37*	04*, 21*	
15	231	230	241	08, 09	06	Branches 481 (1965 — 90 br. —56 br.) 28 (1959 — 65 br.) 17 (1959 — 37 br.) are common to 15 and 49 of R 44
	232					
	233					
	239					
	241	241		33		
	242	242	242	33		
	243	241, 242	241, 242	33		
	244	481*	481*	28*	17*	
	245	241	241	33	06	
	246					
	247	247	247	34		
	248	241	241	33		

1970		1965		1959		Comments
NACE/CLIO (R 44) Branches and sub-branches	NACE/CLIO Groups	90 br.	56 br.	65 br.	37 br.	
17	252 253 255 256 257 258 259 260	252 253 257 254	252*	31 30	18*	Branches 18 (1959 — 37 br.) 252 (1965 — 56 br.) are common to 17 and 49 of R 44
19	311 312 313 314 315 316	311 312	311 312	38 39	22 20*	Branch 20 (1959 — 37 br.) is common to 13 and 19 of R 44
21	321 322 323 324 325 326 327 328	320	320*	40, 41*	23*	Branch 41 (1959 — 65 br.) is common to 21 and 23 of R 44 Branch 23 (1959 — 37 br.) is common to 21, 23 and 29 of R 44 Branch 320 (1965 — 56 br.) is common to 21 and 29 of R 44
23	330 371 372 373 374	330 370	330 370	41*, 42* 49	23*, 24* 26*	Branch 26 (1959 — 37 br.) is common to 23, 29, 51 and 55 of R 44
25	341 342 343 344 345 346 347	340	340	42*	24*	Branch 42 (1959 — 65 br.) is common to 23 and 25 of R 44 Branch 24 (1959 — 37 br.) is common to 23 and 25 of R 44
27	351 352 353	350	350	45	25*	
29	361 362 363 364 365	361 362 363 364 490*	361 320* 363 320* 490*	43 44 47 48 50*	25* 23* 25* 23* 26*	Branch 23 (1959 — 37 br.) is common to 21, 23 and 29 of R 44 Branch 320 (1965 — 56 br.) is common to 21 and 29 of R 44
31	412	412	412	10	07*	Branch 25 (1959 — 37 br.) is common to 27 and 29 of R 44

1970		1965		1959		Comments
NACE/CLIO (R 44) Branches and sub-branches	NACE/CLIO Groups	90 br.	56 br.	65 br.	37 br,	
33	413	413	413	14	07*	Branches 490 (1965 — 90 br. — 56 br.) and 50 (1959 — 65 br.) are common to 29 and 51 of R 44
35	411	411	411	18	07*	Branch 26 (1959 — 37 br.) is common to 23, 29, 51 and 55 of R 44
	414	414	414	11	08	
	415	|	|	|	|	
	416	416	416	15	|	Branch 07 (1959 — 37 br.) is common to 31, 33 and 35 of R 44
	417	|	|	|	|	
	418	|	|	|	|	
	419	|	|	|	|	
	420	420	420	12	|	
	421	421	421	13	|	
	422	422	422	16	|	
	423	423	423	|	|	
37	424	424	424	17	09	
	425	|	|	|	|	
	426	|	|	|	|	
	427	|	|	|	|	
	428	|	|	|	|	
39	429	429	429	19	10	
41	431*	431	431	20	11	
	432*	432	|	20, 22	11, 12	
	436	436	|	21	11	
	438	432	|	20, 22	11, 12	
	439	|	|	|	|	
	453*	453	453	22	12	
	455	432	431	20, 22	11, 12	
	456	453	453	22	12	
43	441	441	441	27	13	
	442	442	442	|	|	
	451*	451	451	23	|	
45	461	461	461	24	14	
	462	|	|	|	|	
	463	|	|	|	|	
	464	|	|	|	|	
	465	|	|	|	|	
	466	|	|	|	|	
	467	467	|	|	|	
47	471	471	471	25	15	
	472	472	|	|	|	
	473	473	473	26	16	
	474	|	|	|	|	
49	481	481*	481*	28*	17*	Branches 481 (1965 — 90 br. — 56 br.) 28 (1959 — 65 br.) 17 (1959 — 37 br.) are common to 15 and 49 of R 44
	482	|	|	|	|	
	483	483	252*	29	18*	Branches 18 (1959 — 37 br.) 252 (1965 — 56 br.) are common to 17 and 49 of R 44

1970		1965		1959		Comments
NACE/CLIO (R 44) Branches and sub-branches	NACE/CLIO Groups	90 br.	56 br.	65 br.	37 br.	
51	491 492 493 494 495	490*	490*	50*	26*	Branches 490 (1965 — 90 br. — 56 br.) and 50 (1959 — 65 br.) are common to 29 and 51 of R 44 Branch 26 (1959 — 37 br.) is common to 23, 29, 51 and 55 of R 44
53	505 506 507 509	501 502 501	501	51	27	
55	620 671 672*	620 671 672	620 671 672	52 46 —	26* 25 —	Branch 26 (1959 — 37 br.) is common to 23, 29, 51 and 55 of R 44
57	610 630 640	640	640	60	30	
59	660	660	660	63*	33*	Branches 63 (1959 — 56 br.) and 33 (1959 — 37 br.) are common to 59, 71, 75, 77, 79, 85, 89 and 93 of R 44
61	710 721 722 723 724 725 730	710 720 730	710*	55 55, 56 57*	29*	Branch 710 (1965 — 56 br.) is common to 61, 63, 65 and 67 of R 44 Branch 29 (1959 — 37 br.) is common to 61, 63 and 65 of R 44 Branch 57 (1959 — 65 br.) is common to 61 and 63 (63.1) of R 44
63 63.1 63.3	741 742 750 741, 742 750	740 750 740 750	710*	57* 58 57* 58	29*	
65	761 762 763 764 771 772 773	760	710*	59	29*	
67	790	790	710*	61	31	
69	811 812 813 820	810 820	810	62	32	

1970		1965		1959		Comments
NACE/CLIO (R 44) Branches and sub-branches	NACE/CLIO Groups	90 br.	56 br.	65 br.	37 br.	
71	830 840	960C* 840	960* 840*	63*	33*	Branches 63 (1959 — 65 br.) and 33 (1959 — 37 br.) are common to 59, 71, 75, 77, 79, 85, 89 and 93 of R 44
73	850	850	840*	64	34	Branch 960 C (1965 — 90 br.) is common to 71 and 79 of R 44
75	93 C 94 C	930 C 940 C	930*	63*	33*	Branch 960 (1965 — 56 br.) is common to 71, 79 and 93 of R 44
77	95 C	950 C	950*	63*	33*	Branch 840 (1965 — 56 br.) is common to 71 and 73 of R 44
79	92 C 96 C 97 C 981 982 983 984	960 C*	960*	63*	33*	Branch 930 (1965 — 56 br.) is common to 75 and 85 of R 44 Branch 950 (1965 — 56 br.) is common to 77 and 89 of R 44
81	91 92 A 96 A 97 A	960 A	960 A	65*	35*	Branches 65 (1959 — 65 br.) and 35 (1959 — 37 br.) are common to 81, 85 and 89 of R 44
85	93 A, B 94 A, B	930 A, B 940 A, B	930*	65*, 63*	35*, 33*	
89	95 A, B	950 A, B	950*	65*, 63*	35*. 33*	
93	96 B 97 B 99	960 B 990 B	960* 990 D	63*	33*	

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